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DEPARTMENT: NURSING

MATRIC NO: 18/MHS02/074

FATS

Fats are important source of energy as (1gm of fat gives 9kcal of energy). They are stored mainly as triacylglycerols (triglycerides) in adipose cells. They constitute 84% of stored energy.

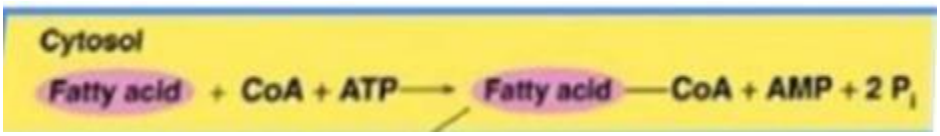
BETA OXIDATION OF FATTY ACIDS

Beta oxidation of fatty acids is the breakdown of fatty acids to acetyl CoA. It occurs in the mitochondria, it is strictly aerobic. After production Acetyl CoA is fed directly into the kreb cycle. It occurs in tissues such as kidney and heart but it does not occur in the brain. The beta oxidation of fatty acids involves three stages:

- Activation of fatty acids in the cytosol.
- Transport of activated fatty acids into mitochondria (carnitine shuttle).
- Beta oxidation proper in the mitochondrial matrix.

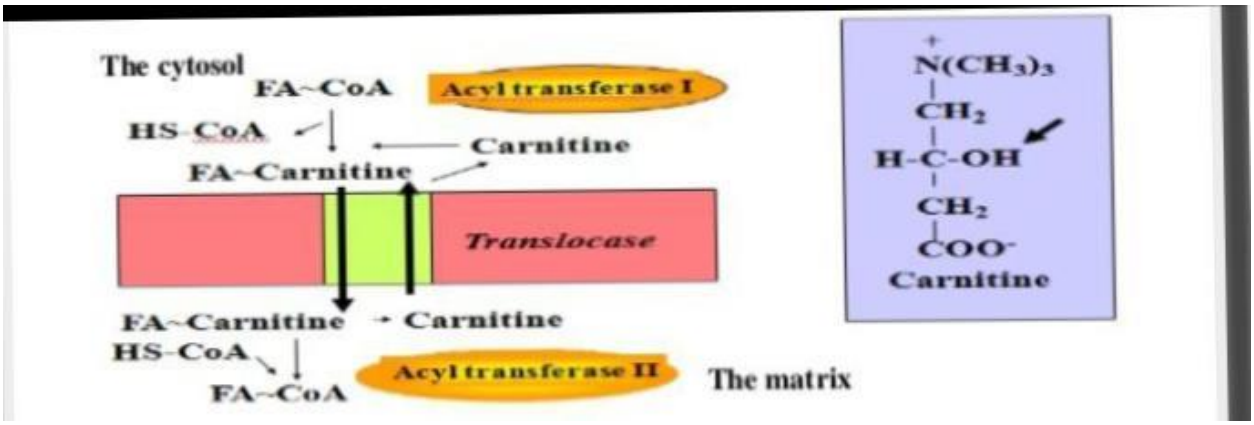
1) ACTIVATION OF FATTY ACID:

This proceeds by **FA THIOKINASE** (acetyl CoA synthesase) present in the **cytosol**. **THIOKINASE** requires ATP, COA, SH, Mg^{++}. The product of this reaction is **FA ACETYL CoA** and **WATER.**



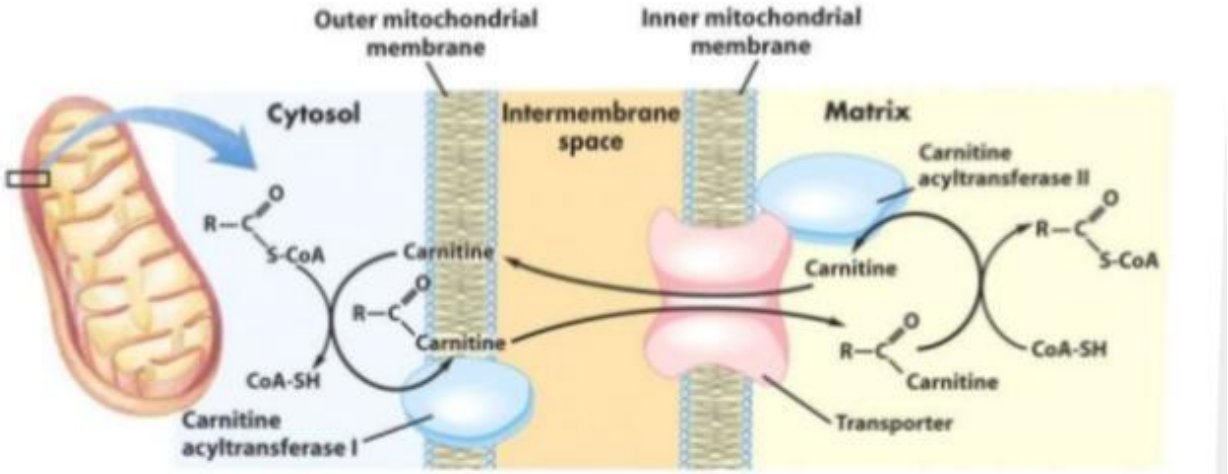
2) TRANSPORT OF ACTIVATED FATTY ACIDS INTO THE MITOCHONDRIA:

Long chain acetyl CoA tranverses the inner mitochondria membrane with a special transport mechanism called **CARNITINE SHUTTLE**



TRANSPORT OF ACETYL CoA INTO THE MITOCHONDRIA (RATE TIMING STEP)

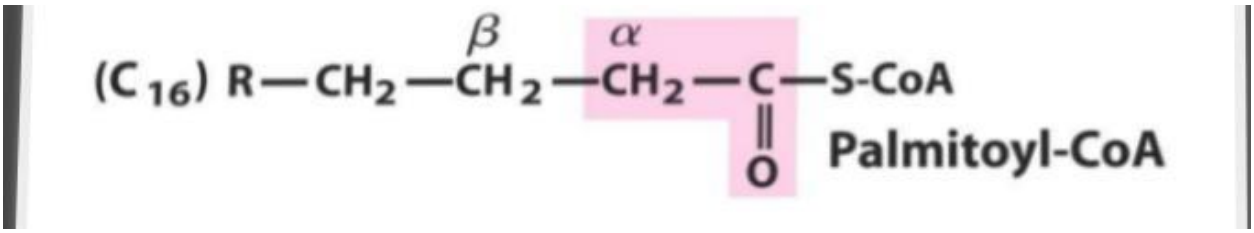
- Acetyl groups from acetyl CoA is transferred to carnitine to form acetyl carnitine catalysed by carnitine acetyltransferase I in the outer mitochondrial membrane.
- Acetyl carnitine is then shuttled across the inner mitochondrial membrane by a translocase enzyme.
- The acetyl group is transferred back to CoA in matrix by carnitine acetyltransferase II
- Finally, carnitine is returned back to the cystolic side by translocase, in exchange for an incoming acetyl carnitine.



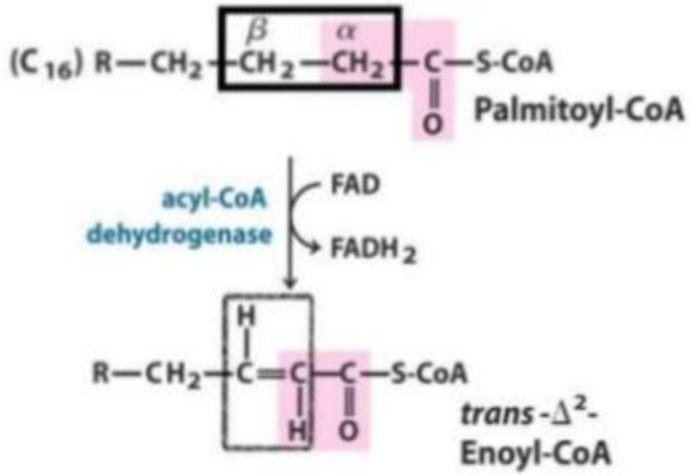
3) **Proper of beta- oxidation in the mitochondrial matrix**

There are 4 steps in beta-oxidation

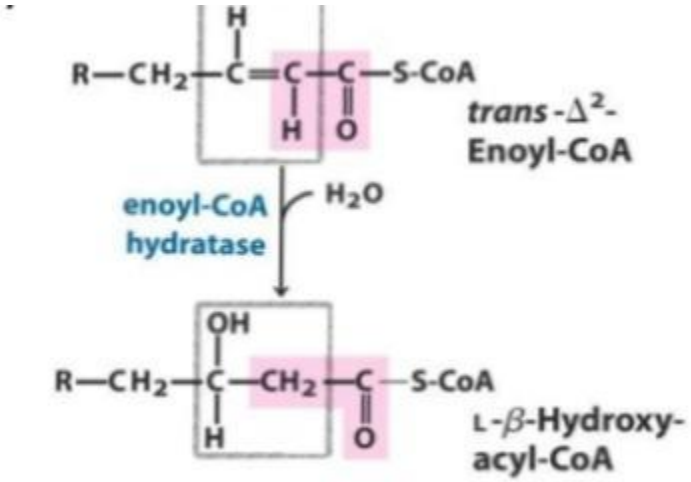
- Step 1- Oxidation by FAR Linked dehydrogenase
- Step 2- Hydration by Hydratase
- Step 3- Oxidation by NAD linked dehydrogenase
- Step 4- Thiolytic cleavage Thiolase



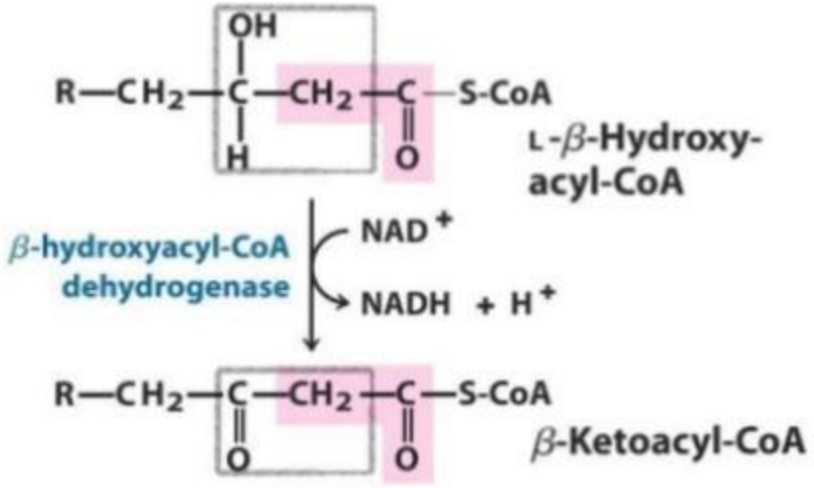
The first reaction is the oxidation of acetyl CoA by an acetyl CoA dehydrogenase to give alpha- beta unsaturated acetyl CoA (enoyl CoA). FAD is the hydrogen acceptor.



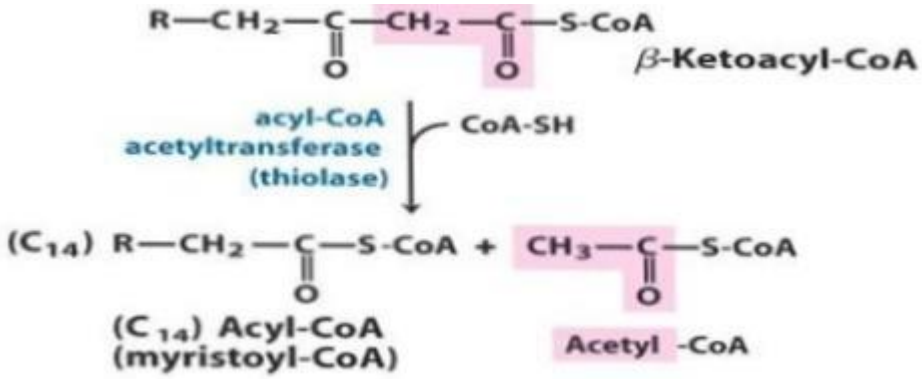
The second reaction is the **hydration** of the double bond to beta-hydroxyacetyl CoA (p-hydroxyacetyl CoA)

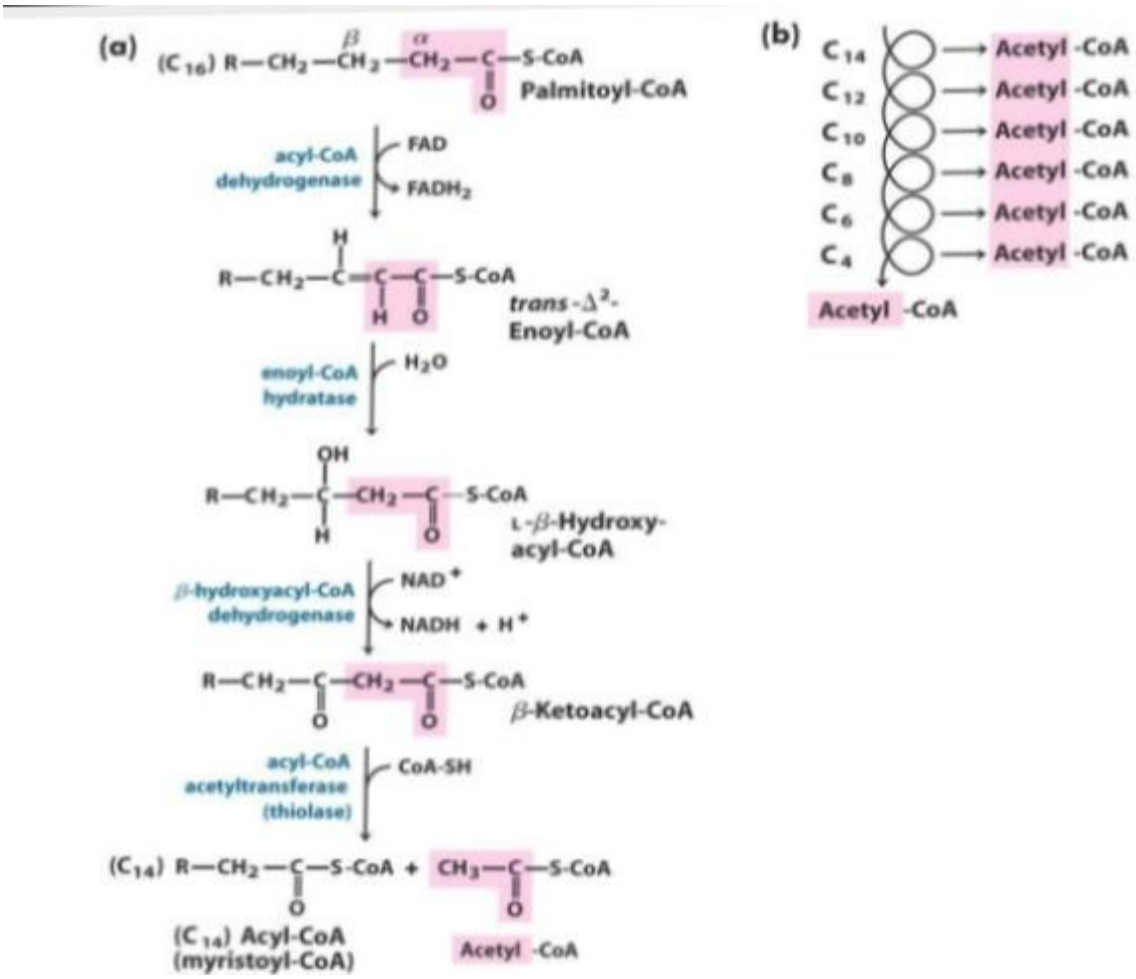


- **The third reaction is the oxidation of beta-hydroxyacetyl** CoA to produce beta-ketoacetyl CoA a NAD- dependent reaction.



- The fourth reaction is the cleavage of the two carbon fragment by splitting the bond between alpha and beta carbons.
- By thiolase enzyme.





- The release of acetyl CoA leaves an acetyl CoA molecule shortened by 2 carbons
- This acetyl CoA molecule us the substrate for the next round of Oxidation <u>starting with acetyl CoA dehydrogenase</u>
- Repetition continues until all the carbons of the original fatty acetyl CoA are converted to acetyl CoA.
- In the last round a four carbon acetyl CoA (butyryl CoA) is cleaved to 2 acetyl CoA.
- **<u>Energetics of FA oxidation e.g Palmitic (16C):</u>**
  1) Beta-oxidation of Palmitic acid will be repeated 7 cycles producing 8 molecules of acetyl CoA.
  2) In each cycle FADH2 and $NADH+H^+$ is produced and will be transported to the respiratory chain.
     - $FADH^2$-----→ 2ATP
     - $NADH + H^+$ -→ 3 ATP
     - So 7 cycles. 5×7 = 35 ATP
  3) Each acetyl CoA which is oxidized in citric cycle gives 12 ATP (8 × 12 = 96 ATP)
  4) 2 ATP are utilized in the activation of fatty acid(it occurs once).
     - Energy gain= energy produced – energy utilized
       = 35 ATP + 96 ATP – 2ATP = 129 ATP